The Servicification of the U.S. Economy: The Role of Startups versus Incumbent Firms*

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Preliminary Version

December 20 2019

1. Introduction

The last few decades have shown a fundamental shift in the U.S. economy from manufacturing towards services (Figure 1). This trend has raised concerns that the shrinking manufacturing sector may hamper the overall rate of innovation. However, unprecedented growth in one important subcategory of services – "supply chain traded services" – suggests a more optimistic view. Outpacing the growth of other services, Supply Chain Traded Services (i.e., service inputs sold to businesses and the government) represents a set of industries that account for a disproportionately high share of STEM jobs in the U.S. economy (Delgado and Mills, 2018). The economic importance of these services is evidenced in the rising salience of industries such as computer programming, data processing and hosting, design, and logistics services (Delgado and Mills, 2018; Gawer and Cusumano, 2002; Bitner, Ostrom, and Morgan, 2008; Sheffi, 2012).

While prior studies have documented the shift in the U.S. economy from manufacturing to innovative services (Delgado and Mills, 2018; Eckert, Ganapati, and Walsh, 2019), understanding the causes and sources of this transition is in its infancy. In particular, little is known regarding the types of firms – startups or established firms – that are driving the transition to Supply Chain Traded Services. In this chapter, we explore the role of three types of firms as potential drivers of growth in these innovative services. First, we analyze the entry and growth of new and young firms like Point API and Rapid7, enabled by new technology and data. Second, we examine the transformation of manufacturing incumbent firms into services over the past few decades, including Cisco, IBM, Intel, and Dell Technologies (Baines et al., 2017; Lodefalk, 2017). Third, we explore the growth of incumbent Supply Chain Traded Services firms like Microsoft and Accenture.

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To implement our analysis, we use the Longitudinal Business Database (LBD), which is a panel dataset of all establishments in the U.S. economy with at least one paid employee. The longitudinal nature of the LBD allows us to distinguish new and young startups from incumbent firms, and track important business characteristics including employment and payroll. We then categorize each establishment's underlying industry (e.g., Supply Chain Traded Services) using the categorization developed by Delgado and Mills (2018). Our sample covers all U.S. establishments between 1998 and 2015, capturing the economic activity (employment and wages) in each sector by each firm type.

In this chapter, we focus on the types of firms and industries that are leading the transformation into high-wage, high-growth services. Our analysis helps frame innovation and entrepreneurship policies targeted towards the good jobs of the future – especially those that address the types of skills and innovation ecosystems that can better support innovative services.

2. Pessimistic View of the U.S. Economy: Manufacturing vs. Services

Many U.S. politicians and policymakers appear to believe that the best way to rebuild the economy is to bring manufacturing back. The innovation debate has remained largely centered on manufacturing because it accounts for the vast majority of patents, while services tend to be viewed as low technology and lower-wage. The focus on manufacturing has resulted in a pessimistic view of the economy reflecting the decline in manufacturing jobs, which has been attributed in part to an increase in imports from China (Acemoglu et al., 2016). From 1998 to 2015, manufacturing employment declined by more than 32%, while services grew by 25% (Figure 1). However, this view is misleading, since manufacturing currently comprises only around 9% of employment and services are extremely heterogeneous – ranging from engineering and cloud computing to retail and restaurants. This chapter focuses on the hidden role of suppliers of services in innovation and the jobs of the future.

2.1. A New Framework: The Supply Chain Economy

In recent work, Delgado and Mills (2018) develop a new innovation framework that focuses on the suppliers of goods and services to businesses and the government: the "Supply Chain Economy." It includes businesses producing inputs (vs. consumer products): e.g., semiconductors, cloud computing, design, and engineering services.

Suppliers are a source of innovation due to three important conceptual attributes. First, they create specialized inputs that can make the innovation process more efficient (Rosenberg, 1963). Second, they possesses numerous layers of buyer industries so that inventions developed by suppliers may diffuse more broadly to other downstream industries. At the extreme, some innovative inputs (e.g., semiconductors) become general purpose technologies (Bresnahan and Trajtenberg, 1995). Third, suppliers fuel

geographical clusters, which spur innovation through the generation of agglomeration benefits (Chinitz, 1961).

To quantify the role of suppliers on innovation and jobs, Delgado and Mills (2018) provide a new industry categorization: Supply Chain vs. Business-to-Consumer industries. Using the 2002 Benchmark Input-Output Accounts of the Bureau of Economic Analysis (BEA), they separate supply chain (SC) industries (i.e., those that sell primarily to businesses or government) from business-to-consumer (B2C) industries (i.e., those that sell primarily to consumers).[1] They find that there is a distinct and large supply chain economy that accounts for 43% of U.S. jobs (53 million) and for most STEM jobs and patents (87%) as of 2015.

In contrast to other industry categorizations that condition on industries that are STEM or knowledge intensive (e.g., "advanced industries" (Muro et al., 2015) or "skilled traded services" (e.g., Eckert, Ganapati, and Walsh, 2019)), the supply chain economy focuses on the suppliers because of their conceptual importance for innovation. The empirical findings show that supply chain industries do, in fact, have a high concentration of innovative activity, as measured by STEM jobs and patents.

Delgado and Mills (2018) combine their categorization with two prior industry categorizations, Traded vs. Local and Manufacturing vs. Services, to analyze specific subcategories of the economy (See full SC vs. B2C categorization in Figure 2).[2] They find that SC Traded Services are distinct and matter for innovation. This subcategory encompasses more than 200 industries, including data processing and hosting (i.e., cloud computing), design, engineering, R&D, marketing, logistics, and software services. This is a large part of the economy with 20% of all jobs and 17% of firms. These services have the highest wage jobs and are marked by the highest STEM Intensity (17 out of 100 jobs are in STEM Occupations), but account for relatively few patents (9%). Importantly, they have experienced fast growth in terms of jobs and wages during the 1998-2015 period (Figure 1).

What could explain this high growth? These industries have many layers of buyer industries (based on the measure of industry upstreamness developed by Antràs et al. (2012)). This attribute, together with their high STEM intensity, can increase their ability to produce specialized inputs for distinct industries, and cascade and diffuse innovation (e.g., cloud computing services).

[1] SC industries are those with low sales to Personal Consumer Expenditures ($\leq 35\%$); and B2C industries otherwise. Alternative SC industry definitions are tested in the Appendix of Delgado and Mills (2018).
[2] Traded industries are those that sell their output across regions and countries, as opposed to industries that primarily serve the local market (e.g., retail). This categorization was initially developed by Porter (2003).

While the number of manufacturing jobs have decreased over time, many high-wage jobs were created in SC Traded Services. By separating STEM-intensive and high-wage SC Traded Services from low-STEM and low-wage B2C Main Street services (like retail and restaurants), we are able to offer a more optimistic and nuanced view of today's service-oriented economy.

What firms are driving the growth in SC Traded Services? We examine three types of firms that may be contributing to the growth: new and young firms (e.g., Rapid7 and ShipHawk); manufacturing incumbent firms (e.g., IBM and Intel); and service incumbent firms (e.g., Microsoft and IDEO). Understanding the types of firms that are driving this change is important, as each may require distinct policy initiatives to access skilled labor, capital, buyers, and other growth-enhancing resources.

3. Data: Mapping Firms by Sector and Age

In this study, the Longitudinal Business Database (LBD) serves as the primary dataset. The LBD is a panel dataset of all employer establishments in the U.S. economy. The LBD provides important establishment-level characteristics including employment size, payroll, industry, and location. Spanning from 1976 to 2015, the LBD covers all industries in the private non-farm economy and every state in the US. While the underlying observations are at the level of the establishment, the LBD assigns a unique firm identifier to each establishment – a useful feature for tracking establishment-level activity for firms with multiple establishments.[3]

In our analysis, the underlying data is at the establishment level. In this approach, each multi-unit firm is decomposed into its portfolio of establishments. We then aggregate economic activity at the sector-level by summing up across all establishments in a given sector (e.g., manufacturing vs. services). Therefore, a multi-unit firm with establishments spanning multiple sectors contributes to each sector based on its establishment-level activity. In measuring economic activity, we primarily use employment and payroll (adjusted to $2015).

Firm-Level Attributes: Primary Industry and Age

As mentioned above, in measuring aggregate activity, we use establishment-level statistics to capture a multi-unit firm's contributions across multiple sectors. However, for analyses that examine firms in certain sectors (e.g., incumbent manufacturing firms in 1998; Figures 6-9), we define each firm's primary industry using its firm-level employment.[4] We then use the primary (six-digit NAICS) industry to classify whether a firm is in Manufacturing, SC Traded Services, or Other Services.

[3] See Jarmin and Miranda (2002) for more information regarding the LBD.

[4] Specifically, for each multi-unit firm, we first identify the two-digit NAICS sector that accounts for the highest share of the firm's employment. Within this two-digit industry, we then identify the three-digit NAICS industry with the

We also use the LBD to separate new firms (age 0), young firms (ages 1-10), and mature or incumbent firms (ages 11+). These cut-offs are based on the first year in which a firm's establishment appears in the LBD. It is important to note that there is a non-trivial share of firms that have a missing firm age in the LBD (e.g., see "unmatched" in Table 1).

To quantify the economic activity in SC Traded Services in the U.S. economy, we use the Supply Chain vs. B2C Industry Categorization for 6-digit NAICS (Delgado and Mills, 2018), which is publicly available.[5] For most of our analyses, we report aggregate economic activity in each sector (e.g., service) by each firm type (i.e., new, young, and mature).

4. SC Traded Services: Employment and Wage Trends by Firm Age

There is a puzzling trend reflected in the secular decline in overall startup activity (Decker et al., 2014) versus a gradual rise in high-quality startups in the U.S. economy (Guzman and Stern, 2016). Understanding the role that young firms play in explaining the transition towards services may help reconcile this debate. For instance, the decline in new firm formation may be concentrated in B2C Main Street services, while high-growth startups may be occurring in supply chain services where high-skilled jobs are disproportionately created. Surprisingly, our preliminary findings suggest that this is not the case: we find a decline over time in the employment created by new and young firms in SC Traded Services as well as in total services.

Table 1 shows the level and growth in aggregate employment and payroll in the SC Traded Services sector for the three firm types. Mature firms represent 11% of total U.S. employment (with over 14 million jobs in 2015), followed by young firms (with 3.5 million jobs) and new firms (with barely 0.3 million). In terms of wages, all SC Traded Service firms have wages greater than the U.S. average ($50,400), with the highest wages for mature firms ($80,500).

We find that the employment growth in SC Traded Services has been concentrated in mature firms, which created 5.3 million net jobs between 1998 and 2015, and also experienced high growth in wages. In contrast, our preliminary analysis suggests a strong decline in the employment created by new firms and young firms (-50% and -15% growth rate, respectively), with a job loss of 1 million. For total services, we find similar trends but less variance across firm types. Next, we explore why there is a distinct performance in SC Traded Services for new firms versus incumbents.

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highest share of firm's employment. This process is repeated until the six-digit NAICS industry is determined – the firm's "primary" industry.

[5] The full classification of the six-digit industries (NAICS-2012 definition) into these SC and B2C subcategories is available in Delgado and Mills (2018) in the supplemental online Appendix B: Supply Chain and Business-to-Consumer Industry Categorization.

5. The Declining Presence of New Firms in Services

The decline in startup employment in SC Traded Services is due to a 20% decline in new firm entry (from 97,000 in 1998 to 78,000 firms in 2015; Figure 4). There was a similar contraction rate in startup entry in total Services (-18%).

Despite the decline in the overall startup entry, SC Traded Services startups continue to play an important role in innovation and employment, accounting for 19% of U.S. startups during the 1998 to 2015 period. In contrast, in 2015, new manufacturing firms only accounted for 3% of U.S. startups (Figure 5).

Much research has been conducted on the reasons for the startup decline (e.g. Decker et al., 2014; Stern and Guzman, 2016), but no conclusive answer has been found as to the underlying causes. Some high-quality startups have grown fast (Stern and Guzman, 2016) and in some cases, they have been acquired by established competitors (Kim, 2019). Acquisitions of young firms could perhaps explain some of the decline in the employment created by young firms. However, it would not explain the decline in entry of startups, unless firms are being acquired before they have their first paid employee and enter the LBD dataset.[6] The decline may indicate that there are certain barriers that new and young firms face in SC Traded Services, an area for further exploration.

5.1. Company Examples: Potential Challenges Faced by SC Traded Services Startups

There are many new and young firms in SC Traded Services in the U.S. economy (e.g., Point API, ShipHawk, Symbia Logistics, WP Engine, and DirectDefense).[7] However, SC Traded Services firms, and startups in particular, face challenges in access to skills and capital that may limit their growth (Delgado and Mills, 2017). To scale up, they must integrate their specialized service inputs in the value chain of business customers. For example, Tulip Interfaces produces an industrial app for the organization of work in manufacturing plants. To scale up, they must create a smart app that can be tailored to the needs of their distinct customers. Thus, access to nearby buyers and capital could be particularly important for startup growth.

Another challenge is the protection of startup innovations from (big tech) competitors in the absence of intellectual property. These services are not patent-intensive, and could be easily copied or simultaneously developed by established firms with better access to complementary resources (e.g., data). For example, MIT startup Point API (previously called EasyEmail) launched in 2016 with the goal of using

[6] We should recognize that the inflow of new establishments may be recorded in the LBD data with some delay, with Census years being most accurate in recording new establishments.

[7] These examples are based on public databases (including Crunchbase), an interview with Mark Gillett at Silver Lake Partners, and a startup panel (including the founders of Tulip and Point API) organized by one of the authors on "How Supply Chain Startups Engage with the Innovation Ecosystem," Frontiers of Innovation and Entrepreneurship Workshop, MIT Sloan, June 2019.

algorithms to predict the reply to an e-mail. Soon after their launch, Google announced a similar tool during their annual conference for software developers, which discouraged some investors.[8] Point API has responded by positioning its software for customer support businesses, but the challenges of protecting their innovation remains.

6. Servicification of Manufacturing Incumbents

We found that the employment growth in SC Traded Services has been concentrated in mature firms (Section 4). This raises the question of whether or not this growth is associated with incumbent manufacturing firms transforming into services. In fact, there has been a large decline in manufacturing employment in the last decades (Figure 1). There is also evidence that manufacturing firms have been transforming into services. Recent trade studies show an increasing use of services for the production of final manufactured goods (Low, 2013; Lodefalk, 2017). In these studies, service inputs are often classified as "intangibles," and their contribution to the value added of final goods or services is not properly measured (Timmer et al., 2014 and Lodefalk, 2017). In the operation management literature, there is increasing focus on product-service systems firms (see literature review by Baines et al., 2017). Relatedly, information and communication technologies (ICT) and management practices could facilitate the modularity and separation of research, development, design, and manufacturing (Tripathy and Eppinger, 2013; Fort, 2017).

We are interested in quantifying the servicification of manufacturing firms and whether or not it resulted in net job creation. To quantify the transformation of manufacturing firms into services, we use a representative sample of about 2,000 incumbent manufacturing firms. We condition on firms that in 1998 (our initial year) are mature (+11 age), large (+500 jobs), and their main employment is in manufacturing. We condition on survivors 1998-2015 in order to quantify the extent to which they do transform. In 1998, these firms accounted for 5.6 million jobs, 33% of total manufacturing employment.

We find that there is a large servicification of manufacturing incumbents that occurs gradually and continuously during the examined period (Figures 6-9). The aggregated employment of the manufacturing incumbent sample is used to compute the share of employment in Manufacturing versus SC Traded Services versus Other Services over time (Figure 6). The share of employment in total services increased by 13 percentage points (24% to 37%). Most of the growth is in the share of employment in SC Traded Services, which increased by 10 percent points (18% to 28%).

[8] The Economist, "American Tech Giants Are Making Life Tough for Startups" (June 2, 2018).

The servicification is even more pronounced when we look at payroll, indicating that the jobs in services exhibit higher average wages (Figure 7). The share of payroll in Services has increased by 17 percent points (31% to 48%) and in SC Traded Services by 15 percent points (26% to 41%).

This servicification took place through the destruction of many manufacturing jobs, and the creation of fewer, yet very high-wage jobs (Figures 8-9). From 1998 to 2015, these firms experienced a total job loss of 1.2 million, but a payroll increase of $4.2 million. Manufacturing lost 1.7 million jobs and $80.1 million in payroll. In contrast, SC Traded Services gained 400 thousand high-wage jobs and payroll increased by $75.6 million (in 2015 USD).

Are the results driven by a few 'superstar' firms (Autor et al., 2017)? Our analysis suggests that many manufacturing incumbent (survivor) firms experienced servicification. We find that by the end of the period, about 20% of the firms have transformed into primarily SC Traded Service firms (i.e., the primary 6-digit industry by employment is in SC Traded Services). Furthermore, we also find similar servicification patterns for a large sample of small and medium manufacturing incumbents.

6.1. Company Examples: The Gradual Servicification of IBM and Intel[9]

IBM: International Business Machines Corporation (IBM) was founded in 1896 as a punch-card data processing machine manufacturer. It found its footing as a hardware manufacturing company in the 1900s. Making all of its components in-house, IBM become the leading computer company in the 1960s amongst a group of eight heavyweights (including UNIVAC, Burroughs, General Electric, and Honeywell), leading market pundits to label them "IBM and the seven dwarfs" (Rothaermel et al., 2015). But with the emergence of Apple in 1976 and other competitors in the personal computer and related hardware space, IBM has been forced to revise its strategy. Each change in top leadership has been associated with an increased focus on software and other services, particularly the bundling of these components together in an integrated sales offering. Indeed, in 2015, IBM's primary (6-digit NAICS) industry was *Computer Systems Design Services* (Hoovers database).

When Louis Gerstner stood at the helm of IBM from 1993 to 2002, the company coined the term "e-business" in its marketing campaigns, highlighting the company's strategy and new focus on the Internet and its capabilities for businesses. In 2002, Sam Palmisano stepped into the CEO, reorganizing IBM around three complementary segments: hardware, software, and services. His focus on services was undeniable. During his tenure, IBM sold its PC business to Lenovo and over a four year period, spent $11.8 billion to acquire numerous software, cloud computing, and computer service firms (Rothaermel et al., 2015).

[9] In the next version, we will use NETS dataset to quantify some examples of manufacturing firms with a transformation into services (including IBM and Intel).

Virginia Rometty furthered the journey into services when she became CEO in 2012. She told the Wall Street Journal in 2015 that "Hardware was the original soul of this company," but "we can't hold on to our past" (Langley, 2015). In a speech to shareholders in 2016, Rometty highlighted the company's transformation: "IBM…has reinvented itself through multiple technology eras and economic cycles…IBM is becoming much more than a 'hardware, software, services' company. We are emerging as a cognitive solutions and cloud platform company" (IBM, 2016).

Intel: Founded in 1968, Intel Corporation made a name for itself as a semiconductor chip manufacturer. It created a general purpose technology (GPT) and a whole industry – semiconductors – with the Intel 4004 microprocessor (Bresnahan and Trajtenberg, 1995). The success of the personal computer industry in the 1980s led to prime positioning for the company as the go-to supplier of chips for PC manufacturers like IBM. Intel excelled at continuously developing improved versions of its popular microprocessor chips—faster and with increased capabilities—but ran into a significant hurdle when adoption of new models slowed. To combat this lag in sales, the company rolled out a brilliant marketing and branding campaign centered on the now ubiquitous "Intel Inside" tagline and logo (Moon, 2005).

Since those early days, Intel has maintained its dominance in manufacturing PC components, but as the company faces declining PC sales, it has diversified into components for other devices, software, and cloud computing. While the company's primary industry remains in SC Manufacturing (*Semiconductor and Related Device Manufacturing*), it has an increasing presence in SC Traded Service industries (in particular in *Software Publishers*).[10] In 2016, Intel announced significant cuts to its workforce (up to 12,000 jobs) as part of a restructuring effort, stating in a press release that the move was necessary to "accelerate its evolution from a PC company to one that powers the cloud and billions of smart, connected computing devices…Through this comprehensive initiative, the company plans to increase investments in its data center, IoT, memory and connectivity businesses" (Intel, 2016).

In January 2016, in a plan to expand beyond the extremely successful "Intel Inside" campaign, the company revamped its brand messaging: "Intel Inside makes amazing experiences outside." Penny Baldwin, VP and GM of global brand management and reputation explained, "By putting the focus on Intel Inside, we'd gone brand invisible… We're trying to bring our brand from the inside to the outside. From being seen as a PC component to being an experiential exponent and an enabler of experiences…All the research we've done clearly indicates that we're seen as nothing more than a PC processing company. But we're expanding into data, we're creating wearables and we're developing technology for the Internet of

[10] Source: Hoovers.

Things. Those are the businesses that will become increasingly important for our revenue and profitability profile into the future" (Schiff, 2016).

7. The Growth of SC Traded Service Incumbents

Finally, we examine the role of large incumbent SC Traded Service firms (e.g., Microsoft) in the growth of this sector. Industries in SC Traded Services have many layers of buyer industries and therefore could grow quickly themselves. In fact, modern equivalents of GPTs like semiconductors reside increasingly in service inputs, such as cloud computing and artificial intelligence (Delgado and Mills, 2018; Brynjolfsson et al., 2018; Cockburn, Henderson, and Stern, 2018).

For this analysis, we use a sample of about 900 incumbent SC Traded Service firms. These firms have the following attributes in our initial year (1998): they are mature (+11 age), large (+500 jobs), and their main employment is in SC Traded Services. We also condition on survivors 1998-2015 in order to quantify the extent to which they grow. The preliminary analysis suggests that this relatively small number of firms created over 1 million jobs during the 1998-2015 period.[11] Thus, while the job creation debate often focuses on manufacturing, large service inputs firms have created many well-paying jobs.

7.1. Company Examples: Microsoft and Service Platforms

There is no shortage of incumbent services firms that have grown significantly during our time frame, capitalizing on the increasing use of data and Internet, cloud-computing, and AI technology. Examples range from high-growth enterprise software firms and consulting firms such as Salesforce, Workday, SAP, and Red Ventures, to engineering and design service firms like Aecom and IDEO. Microsoft, a well-known incumbent service firm, illustrates the scalability of service inputs.

Microsoft: Founded in 1975, Microsoft was a software company from its outset, developing tools for the emerging PC industry. Microsoft Word was first released in 1983 and quickly took over the marketplace along with the Office suite of applications. Focusing heavily on Windows and Office, Microsoft covered the enterprise software market through licensing agreements up through the 2000s. Gawer and Cusumano (2002) showed the importance of Microsoft Windows platform for the innovation capacity of many of their customers.

By 2013, however, "the sale of prepackaged operating systems and software on PCs" was declining. Consumers were interacting with technology in varied ways with the increasing adoption of smartphones, tablets, and other mobile devices. Responding to these trends, Microsoft reorganized itself as a "devices and services company" and later under Satya Nadella's leadership as a company focused on a "mobile-first,

[11] We will further develop Section 7 after the Census' RDC approves the new analysis implemented for SC Traded Service incumbents.

cloud-first" strategy (Foley, Mayfield, and Boland, 2017). The company developed its fast-growing cloud service, Microsoft Azure, and shifted to a constantly updating subscription model for Office 365. Related cloud-based products like Skype, SharePoint, and the like followed, as Microsoft continues to build out its software-as-a-service (SaaS) empire.

8. Conclusion: How to Support Innovative Service Firms

The servicification of the U.S. economy is a significant source of anxiety due to the loss of well-paying jobs in manufacturing. However, strong growth in Supply Chain Traded Services firms provides an important source of new, high-wage jobs which require STEM skills. This raises important questions, particularly around policy initiatives that might support this new category of innovative service jobs.

One puzzling and alarming finding of our study is the decline in the number of entrepreneurial firms in Supply Chain Traded Services. While young firms in this sector represent a large share of the overall entrepreneurial activity in the U.S., their decline raises questions regarding the "missing" generation of startups in this increasingly important services sector. What are the barriers that stifle the entry and growth of entrepreneurial firms in high-tech services? Given the outsized role of startups in generating technological innovations and growth (e.g., Romer, 1990), future research is needed to advance our understanding of the sources and solutions to these barriers. In particular, barriers related to the access to STEM skills, capital, and buyers, as well as the ability to protect their innovations, should be examined (Delgado and Mills, 2017).

Another key finding in this study is that job creation in SC Traded Services is driven primarily by the transformation of incumbent manufacturing firms into services, especially the growth of incumbent service firms. These findings underscore the importance of training workers with the skills that enable firms to respond to the evolving competitive environment and thereby sustain growth. Current skills initiatives might benefit from a deeper involvement of these firms in designing and funding such programs. Engaging the large, fast-growing technology companies in robust skills and job training initiatives will ensure that more displaced workers will have the opportunity to reskill to obtain jobs that are in high demand.

Additional research questions would also involve better understanding the firms that have transformed successfully from manufacturing into product-service or pure service firms. How does servicification of incumbent firms occur? Generally, firms can transform into these service sectors by organically developing its capabilities in-house (e.g., retraining their workers) or externally sourcing the necessary technology and skills. For instance, prominent firms including IBM, Microsoft, and Intel have frequently acquired startup firms as a way to outsource new technology and talent (Kim, 2019). Relative to organic growth, how does an acquisition-based approach shape the firm's long-run innovation and growth?

While our study uncovers some foundational trends in the U.S. economy from manufacturing to Supply Chain Traded Services, additional research is needed to shed light on the spatial and labor market dynamics underpinning incumbent firms' transformation into these innovative services.

Creating an appropriate business environment for new and young firms to overcome barriers to entry and growth, and for incumbent firms to adapt to changing trends, is essential to encourage growth in supply chain services and innovation in the American economy.

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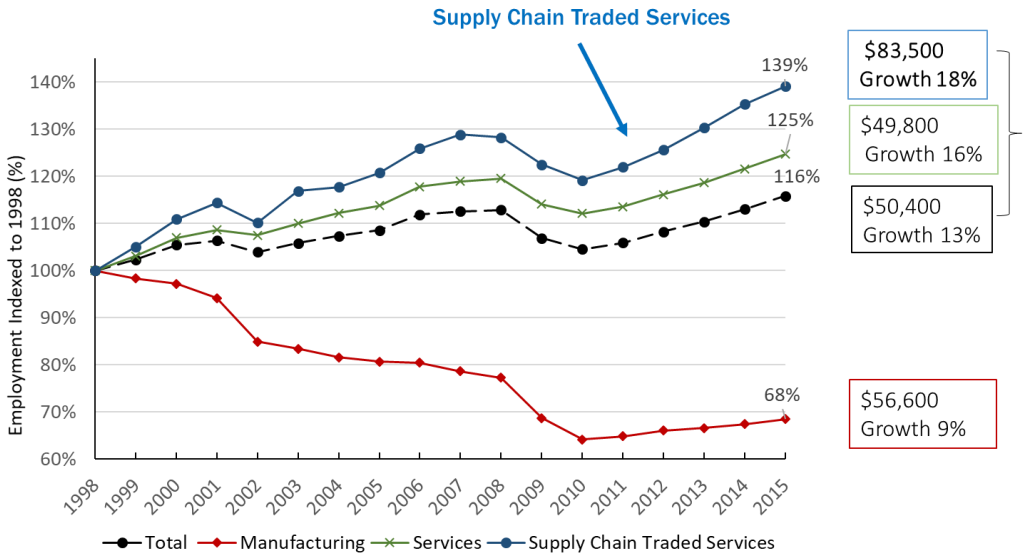
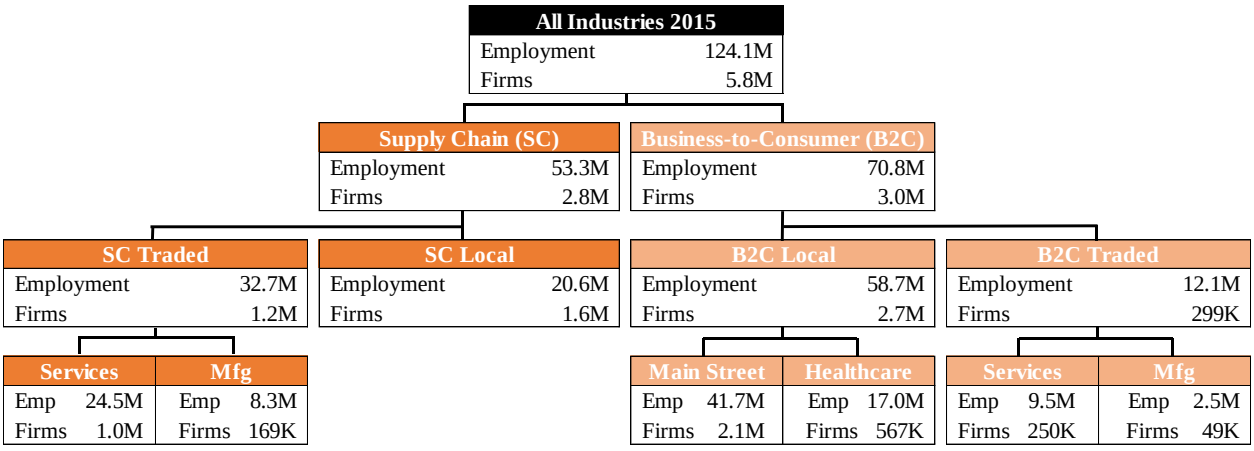
Figure 1. Optimistic View of the Economy: High Growth of Suppliers of Service Inputs



Notes: Source Delgado and Mills (2018). They separate Supply Chain (SC) industries (i.e., those that sell their goods and services primarily to businesses or the government) from business-to-consumer (B2C) industries (i.e., those that sell primarily to consumers).

Figure 2. Full Supply Chain Categorization



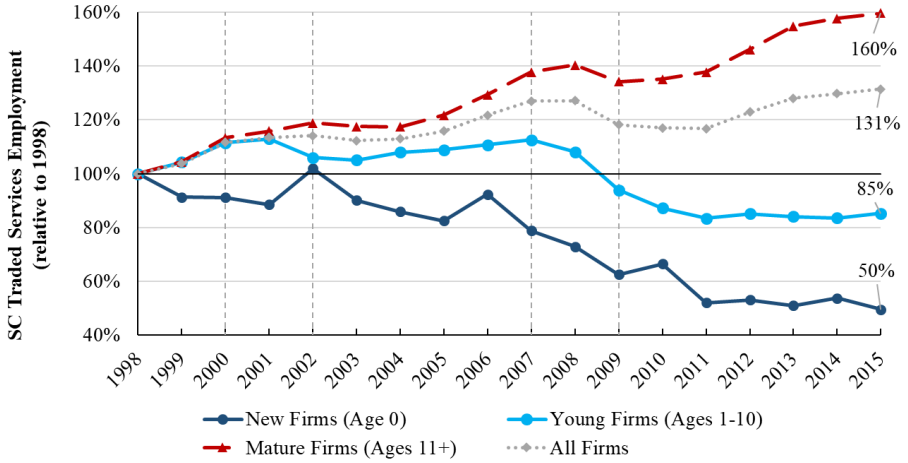
Note: Sourced from Delgado and Mills (2018). Private-sector non-agricultural employment (excluding self-employed). Employment in millions (M) is sourced from CBP 2015 data, and the number of firms in thousands (K) is sourced from the 2012 Economic Census (available at 5-year intervals). The Services category includes Non-Manufactured Goods.

Table 1. SC Traded Services: Employment and Wages by Firm Type (New, Young, Mature)

	Employment				Real Wages (2015 USD)	
	2015 Mill	% Total	1998-2015 Growth	Net Mill	2015 $000	1998-2015 Growth
	1	2	3	4	5	6
Total	**124.1**	**100%**	**16%**	**16.9**	**$50.4**	**13%**
Services	112.5	91%	25%	22.3	$49.8	15%
SC Traded Svc	24.5	20%	39%	6.9	$83.5	18%
SC Traded Svc: New Firms (Age 0)	0.3	0%	-50%	-0.4	$53.1	-2%
SC Traded Svc: Young Firms (Ages 1-10)	3.5	3%	-15%	-0.6	$62.3	14%
SC Traded Svc: Mature Firms (Ages +11)	14.1	11%	60%	5.3	$80.5	16%
SC Traded Svc (unmatched)	6.5	5%	66%	2.6		

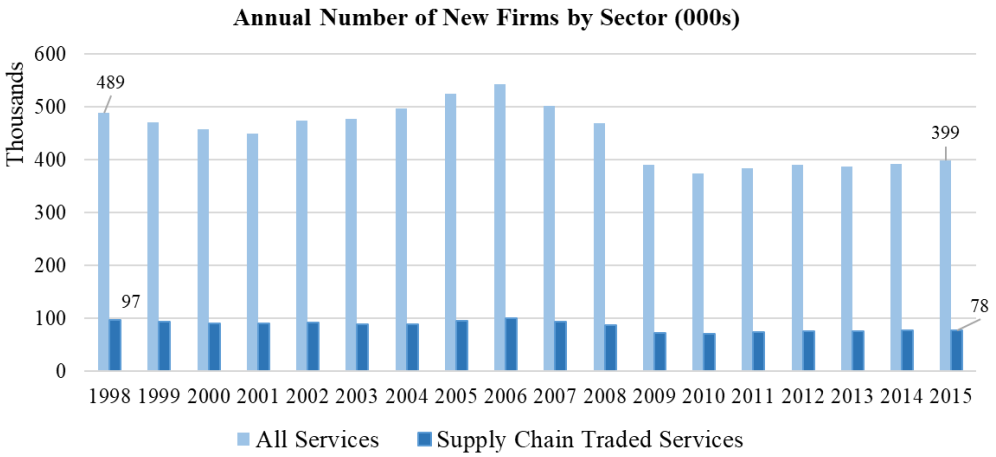
Note: Real wages in 2015 USD using CPI-U (All Urban Consumers; BLS).

Figure 3. SC Traded Services: Employment Trends by Firm Type (New, Young, Mature)



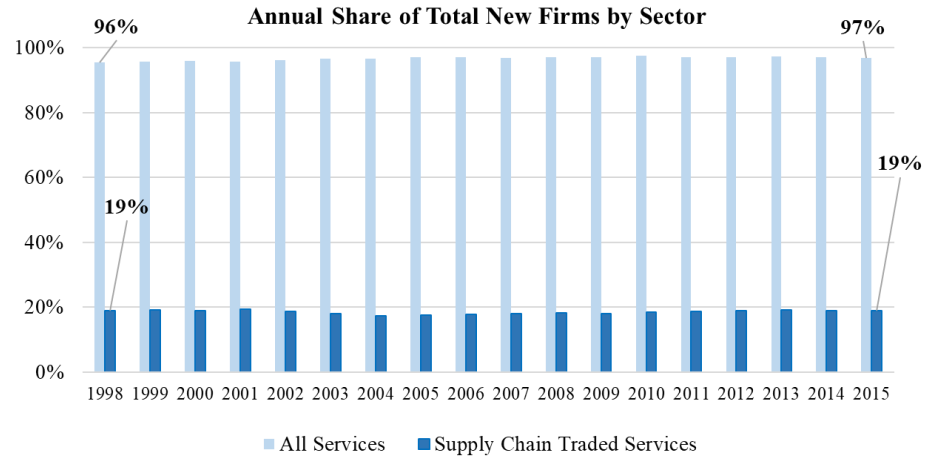
Note: *All Firms* exclude 'unmatched' firms without age or industry match. Age based on the oldest establishment of the firm in the particular year.

Figure 4. Entry of New Firms in SC Traded Services



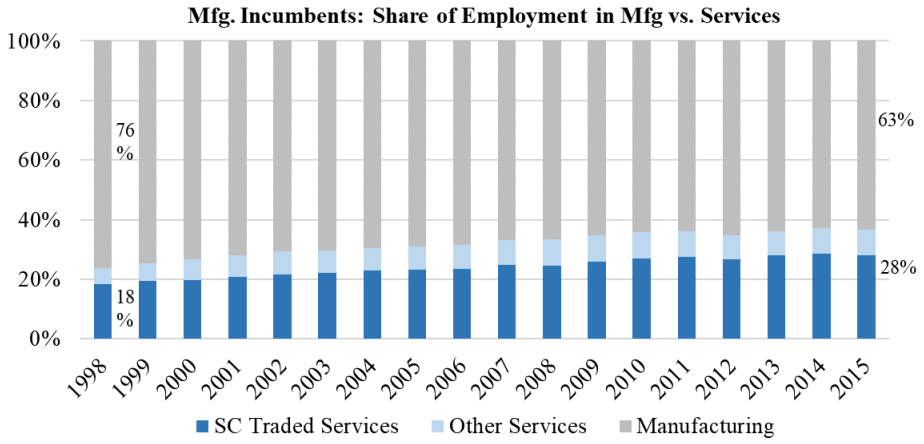
Note: Authors' calculation based on LBD. New firms are those with zero age.

Figure 5. Share of U.S. Startups in Services



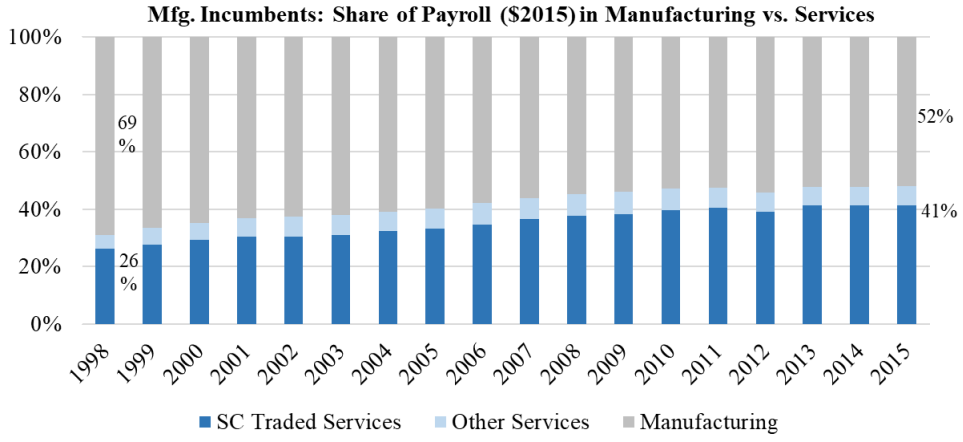
Note: Authors' calculation based on LBD. New firms are those with zero age.

Figure 6. Manufacturing Incumbents: Share of Employment in SC Traded Services



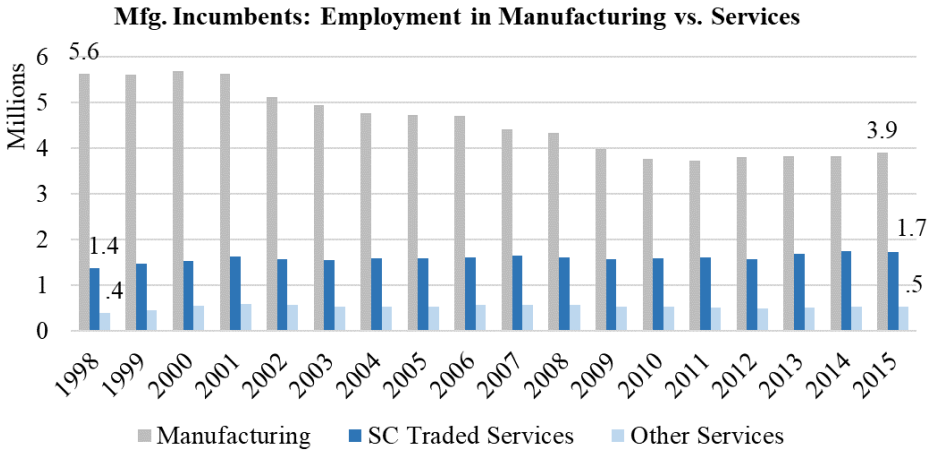
Note: Share of employment in SC Traded Services increased by 10 percent points (18% to 28%).

Figure 7. Manufacturing Incumbents: Share of Payroll in SC Traded Services



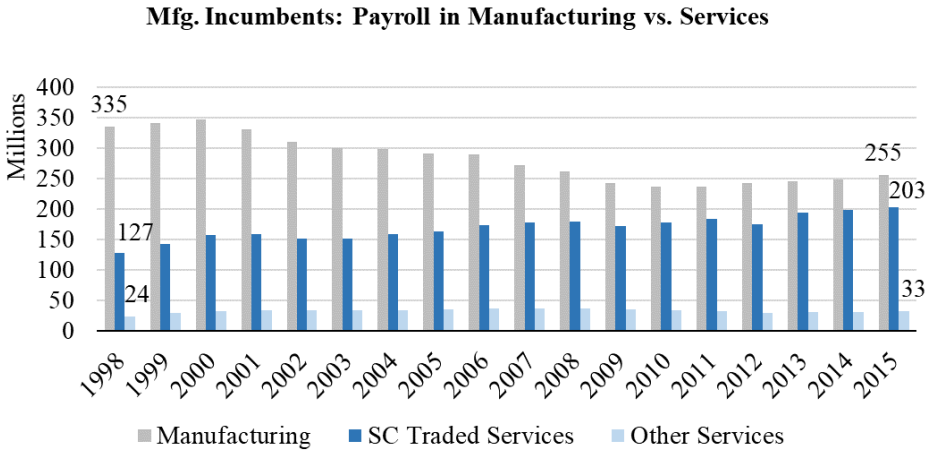
Note: Share of payroll in SC Traded Services has increased by 15 percent points: 26% to 41%.

Figure 8. Manufacturing Incumbents: Employment Trends, 1998-2015



Note: Sample of large firms that are manufacturing incumbents in 1998 and survive 1998-2015.

Figure 9. Manufacturing Incumbents: Payroll Trends, 1998-2015



Note: Sample of large firms that are manufacturing incumbents in 1998 and survive 1998-2015.